

RC-48 SYSTEMS MANUAL
120 VAC MODEL
E.I.L. INSTRUMENTS INC.
10 LOVETON CIRCLE
SPARKS, MD 21152

Revision 3.1 9/86

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RC-48 INSTALLATION GUIDE

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RC-48 PROGRAMMING GUIDE

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The RC-48 is a microprocessor-based refrigeration system controller, either pressure (suction and head pressure) or temperature, specifically designed to control the refrigeration process on parallel or single compressor systems in supermarkets, warehouses, and other cold storage facilities.

This system has the capacity to control up to 8 compressor systems, with 4 compressors per system and 4 condenser fans per system (optional head pressure controller required). It monitors up to 8 suction pressures, 8 head pressures, and 8 temperatures.

The system is custom designed to meet the individual requirements and objectives of a refrigeration process. The RC-48 is a user-friendly, programmable unit with protective control features.

E.I.L. provides sample layout plans created to yield efficient and accurate RC-48 application and operation (see figures 1-4).

Once the system is installed, the unit is programmed on-site. Setpoints that trigger the various control functions are established and entered into the unit. It is also possible to program the system from a remote site using the optional COM-88 communications unit in conjunction with the RC-48.

A battery provides memory/time backup power for up to 2 weeks in the event of a power loss. An optional external alarm system offers additional flexibility in control and monitoring.

II.

SPECIFICATIONS AND FEATURES

A. SPECIFICATIONS

Refrigeration System Control:	8 systems
Compressor Control	4 per system
Analog Temperature Monitors:	8 inputs with a temperature range from -50 to +77 degrees Farenheit
Suction Pressure Monitors:	00 to +117 pounds
Head Pressure Monitors:	00 to +576 pounds
Clock Capabilities:	24 hour, 7 day, 12 month, 1 year programmable clock with automatic Daylight Savings time changeover and 2 week battery backup of program data and timeclock
Defrost Monitor:	One digital monitor per system for use with gas defrost systems
Input:	120 vac, 50/60Hz., single phase, 1 ampere input power. Note: Other voltages available upon request.
Ambient:	40F to 110F, 0-90% relative humidity, noncondensing
Dimensions:	Main Unit (keyboard unit): 20"H x 14"W x 6"D - Wt. 30 lbs. Head Pressure Unit: same as main unit RTS Unit: 10.5"H x 3.5"W x 2"D - Wt. 2 lbs RMA Unit: same as RTS Unit

B. FEATURES

Alpha display of system (rack) designation:	A-H
Alphanumeric display of system description:	Up to 13 characters
Temperature probe identification number:	1-8
Selectable control mode:	Either pressure or temperature
Control sequence:	8 pre-programmed, 4 programmable modes
Control sequence description:	Up to 13 characters
Control Stages:	From 1 to 12
High/low suction pressure control setpoints:	Cut-in/cut-out, 00 to 116 pounds
Head pressure control setpoints:	00 to 575 pounds, 4 fan setpoints
Head differential pressure setpoints:	0-99 pounds
Time delay between condenser fan setpoints:	15,30,45,60 minutes
Temperature control setpoints:	Cut-in/cut-out, -49 to 76F
Control time delays - min on/min off:	0-99 minutes
Temperature compensation setpoints:	High and low -49 to +76F
Temperature alarms high and low setpoints:	-49 to +76F
Temperature alarm delay:	0-99 minutes
Suction pressure alarms high and low setpoints:	00 to 116 pounds
Alarm delay:	0 to 99 minutes

Head pressure alarm high and low setpoints:	0 to 575 pounds
Differential for high head alarm setpoint:	0 to 575 pounds
Head pressure alarm delay:	0-99 minutes
Transducer zero adjust:	Automatic or manual offset

C. OPTIONAL FEATURES

External alarm panel:	Allows external alarm reporting at remote locations.
Remote communications:	When linked to the EIL COM-88, phone line communications to a remote site enables off-site programming. Interrogation of present operation and all set points, including alarm logs.

III.

INSTALLATION GUIDE

This section presents instructional guidelines applicable to the installation of the RC-48 system. Individual system components must be installed in the order in which they are presented. Strict adherence to the outlined procedures and referenced figures must be maintained in order to ensure accurate and efficient performance.

NOTE: All installation procedures must be performed in accordance with National Electric Code NFPA70 and other applicable codes. E.I.L. Instruments does not accept liability resulting from either compliance or noncompliance with the provisions presented in this document.

A. SYSTEM OVERVIEW

A typical EIL energy management and control system would be laid out as illustrated in figure 1.

A typical floor plan illustrating sensor and transducer locations is shown in figure 3.

EIL component symbols with corresponding definitions and abbreviations are presented in Figure 2.

B. RC-48 UNIT INSTALLATION

1. MOUNTING THE UNIT

The main panel should be mounted as outlined in the following steps and as illustrated in figure 13.

- A. Mount the main panel on a permanent wall that can support a weight of 30 pounds and encompass dimensions of 20 x 14 x 6 inches. The wall should be free of vibration associated with the compressor systems.
- B. Secure the panel to the wall using the 4 prepunched holes.
- C. Refer to the wall layout (figure 4) for mounting all of the components of the system.

NOTE: The ambient temperature of the location chosen for the unit must be within a range of 40F to 100F. A noncondensing humidity level must be maintained.

WARNING: Extreme care must be taken to prevent metal filings and other debris from falling into circuit board sections. Drilling should be avoided. Punches should be used if additional holes are needed.

2. OPTIONAL HEAD PRESSURE CONTROLLER

The head pressure controller must be mounted as illustrated in figure 13 and as outlined in the steps listed above for the main unit. This unit should be mounted in close proximity to the main unit for ease in interrogation and troubleshooting.

3. POWER HOOKUP

Line power must be supplied to both the RC-48 main unit (the unit with the keypad) and the optional head pressure controller unit in accordance with figure 13 and as outlined in the following steps.

Main Unit

- A. Remove the grillage in the main unit by removing the screws, nuts and nylon spacers.
- B. Remove the fuse located in the upper right section of the unit. Only replace when ready to power-up unit.
- C. Connect a 120 volt, 50/60Hz, 15 ampere dedicated circuit containing a ground wire to the terminals located in the upper right section of the unit.
- D. Replace the grillage using the nylon spacers (between grill and board), lock washers, and nuts.

Optional Condenser Fan Controller

Use the procedures outlined above for the main unit.

NOTE: Other supply voltages and frequencies for both units will be supplied upon request.

4. UNIT INTERCONNECTION (REMOTE COMMUNICATION)

The main unit and the optional head pressure controller as well as the optional COM-88 unit must be interconnected to provide for proper operation. Use the following steps (where applicable) and refer to figure 13.

- A. Connect a 2 pair, 4 conductor, 22 gauge shielded cable from the RC-48 main unit to the COM-88 as shown on figure 13.
- B. Connect a 4 conductor, 22 gauge shielded cable from the RC-48 main unit to the head pressure controller (TS-1).

5. TEMPERATURE SENSOR INSTALLATION

A. Location

This system has up to 8 sensors that can be used for temperature control (rather than pressure control), or temperature compensated pressure control and temperature alarming. The location of the sensor (if used), is critical to its intended purpose. Refer to the refrigerated case or box manufacturer's instructions for proper location of the sensors. There can be only one sensor per case for temperature control or two sensors per case for compensated pressure control. Any sensor or sensors can be designated for alarm purposes if desired.

B. Sensors

Sensors must be connected in accordance with figure 13 and the following points, in order to ensure durability, accuracy, and efficiency.

1. Always locate connections outside of the refrigerated space.
2. Always use a soldering process or its equivalent to secure the connection.
3. Always insulate connections after completion of soldering.
4. Connect the red lead to the appropriate T# terminal that is located on the input/output board TS-7 on the RC-48 unit, refer to figure 13.
5. Connect the white lead to the appropriate W terminal located on the same terminal strip, TS-7.

CAUTION: Never run sensor wiring in the same conduit as power wiring.

CAUTION: Never run sensor wiring across the electronics in the cabinet.

CAUTION: Always use 18-gauge shielded cable for wiring.

CAUTION: Ground the shield at the master unit end only.

6. COMPRESSOR CONTROL MODULES - RT-5D

A. Requirements

One RT-5D unit is required for each compressor system to be controlled.

RT-5D Mounting - Refer to figure 14.

1. Mount the plastic track in the compressor control cabinet box where it is serviceable.
2. Snap the relay board into the track.
3. Hookup 240 volts AC to the input power terminals on the relay board. Remove the power fuse before connecting power, and do not connect it until the startup operation. Be sure that the jumpers that select the proper voltage are correct. The units are shipped from the factory in the 240 volt mode unless ordered otherwise.

RT-5Ds may be powered from a separate control circuit on a breaker panel, or to a circuit breaker in its appropriate compressor rack. It is important to keep each RT-5D wired separately for ease of maintenance.

B. Wiring Connections for RT Unit

1. Connect a 10 conductor 22-gauge shielded control cable leading from the main unit to each RT unit. Connect as shown on figures 13 and 14.

NOTE: TS-2 = System A & B
TS-3 = System C & D, etc.

2. Break the compressor control circuits (in series with existing controls) through the terminal strips on the RT units labeled Comp.1, Comp.2, Comp.3, Comp.4. Leave the over-ride switches in over-ride until installation is complete and system is ready for startup.

7. CONDENSER CONTROL MODULES - RM-4 MODULES

A. Requirements

These units are required for the optional head pressure control only. One RM unit is required for each compressor system.

B. RM-4 Mounting

Mount the RM Unit in the Condenser Fan Control box using the same procedure outlined previously for the RT unit as shown in figure 15.

C. RM Connections for the RM Unit

1. Connect an 8 conductor 22-gauge shielded control cable from the RC-48 optional condenser fan controller unit to each RM module. Connect as shown in figure 15. Power RM modules with 240 VAC.
2. Break the condenser fan contactor controls (in series with the existing controls) through the terminal strips on the RM units, Comp.1, Comp.2, etc., and leave the switch in over-ride until installation is complete and system is ready for startup. It is important that each RM-4 is powered separately for ease of maintenance.

8. TRANSDUCERS

Transducers must be installed in accordance with figure 14 and the following steps, in order to ensure accuracy and efficiency.

1. Install the fittings and shut off valves as shown in figure 14 on the appropriate suction and/or head manifolds.
2. Connect the wiring leading from the transducer to the terminal strip located in the upper left section of the RT-5D board. Connect like terminal to like terminal, using figure 14.

NOTE: Leave the valve turned off and the transducers disconnected until the startup sequence.

Do not apply pressure to the transducers until startup. They must be zero adjusted with no pressure applied. When connecting the transducer to the valves, backup with a wrench to prevent damage to the transducer.

RC 48 PROGRAMMING GUIDE

I. GENERAL

A. MASTER CLEAR

Once installation is complete and an initial power up done, the RC-48 System should be cleared.

1. Push the CLEAR SWITCH located on the top right side of the CPU board to the right and hold it.
2. Remove the AC power fuse (disconnect power) located on the top of the unit and reconnect it.
3. Push down the PROGRAM SWITCH on the left side of the CPU board and hold it while still holding the CLEAR SWITCH.
4. Release the CLEAR SWITCH.
5. Release the PROGRAM SWITCH.

The RC-48 System is now ready for programming.

B. RUN MODE-PROGRAM MODE

The normal operating mode for the RC-48 control is the run mode. The correct time of day, in military time, is normally displayed. The RC-48 will revert to the run mode automatically after 15 minutes if the operator fails to switch the unit from the program to the run mode.

Place the unit in the program mode by sliding the spring switch inside the door, on the lower left portion of CPU board. (At least one entry must be made before unit may be returned to the run mode).

The RC-48 display will show **PROG** or **PROGRAM** as soon as the unit is placed in the program mode.

C. SELECTING RACK OR SYSTEM NUMBER - RACK DESCRIPTION

Once in the program mode a particular rack must be selected -- A,B,C,...H. The RC-48 has the ability to control up to 8 compressor racks, A-H. A rack may be defined as a single compressor or up to four compressors in parallel.

Begin by pressing RACK NUMBER/DESCR key.

Select proper rack letter, for instance, "B" and press ENTER key.

The letter of rack selected will appear in left side of display, and a dash will be flashing just to the right. A description may now be typed on display using the Alphabet keys on keypad. Thirteen letters or numbers of description may be used. Numbers may be typed by pressing # key and then pressing the appropriate number, spaces and backspaces by using SP and BS keys (SP =space and BS = backspace) .

When desired description is complete, press ENTER key.

The description of that rack is now entered in memory. Whenever the rack is interrogated, the description will appear in display. In the program mode, when the rack is selected the description will flash. Modifications to the description can be made if necessary, or simply press ENTER key to retain in memory.

Let's assume we had just selected rack "B", and had typed and entered the appropriate description for rack "B". The RC-48 is now locked on rack "B". Any further keyboard parameters are going to refer to rack "B" until we select and enter another system letter. The rack letter, A-H is always indicated in the far left of the display.

After entering the description, the display advances to "CONTROL MODE". The control mode is either pressure or temperature for a given compressor rack or system. In the program mode the +/- key toggles the display from pressure to temperature. Single compressor units may be controlled on either pressure or temperature; parallel systems must be controlled on pressure. For each system, select either PRES. or TEMP. After entering description, press ENTER key to retain in memory.

NOTE #1 — PROGRAM LOOPS

The RC-48 system uses a series of program loops. The "SYSTEM NUMBER/NAME" selection described above and the "SUCTION PRESSURE SETPOINTS" are two such loops. When the loop is entered the user must step through each part of the loop before another function or loop can be started. In the SYSTEM NUMBER/NAME loop above, we entered a rack letter, then typed a description, and finally selected a control mode before the loop was completed. Stepping through the loop can be accomplished in normal programming by entering values where needed, or by continually pressing either the ENTER or EXIT key until the loop is completed and display reverts to PROG in the program mode or the correct time of day in the run mode.

II. PROGRAMMING SYSTEM PARAMETERS—SETPOINTS, TIME DELAYS, ETC.

A. CONTROL SEQUENCE

The RC-48 system has the ability to control parallel compressor systems based on suction pressure. These compressor systems may have up to four compressors in parallel. Sequences for the most common compressor systems in use today—two, three, four compressor parallel, and three compressor uneven—are pre-programmed in the RC-48 system. These systems may be controlled as either alternating or non-alternating systems. The RC-48 also contains four (4) user programmable sequences with up to twelve steps of control for each sequence.

The CONTROL SEQUENCE key acts in both a program function as well as an information function. Control sequences 1-8 are pre-programmed; that is those sequences may be assigned to particular compressor racks and interrogated as to description and operating sequence, but cannot be changed. Sequences 9-12 are user programmable. A sequence description may be typed describing the particular sequence, and up to twelve (12) steps may entered. At each step the user selects which compressors should be running using the +/- and the SP and the BS keys.

Using the CONTROL SEQUENCE key, in either the run or program mode:

Sequence #1—Single compressor unit

Sequence #2—Two compressor non-alternating

Sequence #3—Three compressor non-alternating

Sequence #4—Four compressor non alternating

Sequence #5—Two compressor alternating

Sequence #6—Three compressor alternating

Sequence #7—Four compressor alternating

Sequence #8—Three compressor uneven (where the combined horsepower of the first two machines is greater than the third).

Sequences #9-12—These are user programmable sequences. There are up to 12 stages possible for each sequence.

Example: In the program mode press CONTROL SEQUENCE key.

The display shows:

SEQUENCE NO 00 (with the 00 flashing).
16

Press 09 and then ENTER to gain access to sequence number 9. A description of that sequence may now be typed using the alphabet keys on the keyboard. When the appropriate description has been typed press ENTER to retain in memory. The display now indicates :

N O . S T A G E S 0 0 (with the 00 flashing).

The number of steps or stages in this particular sequence may now be entered. Let's assume this sequence is a three compressor parallel system where the combined horsepower of the first two compressors is less than the third, 3 hp., 5hp., and 10hp. Let's also assume that the first stage will always be all compressors OFF. This particular sequence has 8 steps or stages.

Stage 1= all off. Stage 2= 3hp. on. Stage 3= 5hp. on. Stage 4= 3hp. and 5hp. on. Stage 5= 10hp. on. Stage 6= 3hp. and 10hp. on. Stage 7= 5hp. and 10hp. on. Stage 8= all compressors on. Therefore press 08 for number of stages and press ENTER. Display now indicates sequence:

0 9 S t a g e 0 1 X X X X .

Note #2: X=compressor off
O=compressor on

Note #3: The maximum number of possible compressors, four, are shown in the display.

Since we want stage 1 to have all compressors off, press ENTER. Display advances to:

0 9 S t a g e 0 2 X X X X (with the first X flashing).

Use the SP (space) and BS (backspace) keys to advance or go back to proper compressor, and use +/- key to toggle that compressor ON or OFF. When display indicates appropriate compressors are ON or OFF for that stage, press ENTER key to advance to the next stage.

For example: Stage 2 should have only the 3hp. compressor running. Press +/- key to change the X to an O for compressor #1. Press ENTER . Stage 3 should have only the 5hp. compressor running. Press SP (space)key to space over to second compressor, and then press +/- key to toggle that compressor on.

Press ENTER key to advance to stage 4. Continue until all steps necessary are programmed.

B. SUCTION PRESSURE SETPOINT

The SUCTION PRESSURE SETPOINT key is active when the rack being interrogated or programmed is pressure controlled. That is, this key would be disabled if the rack being programmed or interrogated were being temperature controlled.

1. Select proper rack using RACK NUMBER/DESCR key. Continue through loop using ENTER or EXIT key. If we are already in the correct rack loop, it is not necessary to reselect rack letter.

Ex: Rack B

2. Press SUCTION PRESSURE SETPOINT key. The display indicates:

B SEQUENCE NO. 00 (flashing).

Press appropriate sequence number for compressor rack type: Sequence 09 for a three compressor uneven rack similar to above example.

Press ENTER key.

The description of that sequence now appears in the display.

Press ENTER key.

3. The display now indicates :

B C.I. PRS. -10 -10 (with the last -10 flashing).

The "cut in " pressure setpoint may now be typed in display.

For example: +20 lbs.

Press +/- key to toggle - sign to + or 0 sign. Press 20 for twenty lbs. Example: -20 = minus twenty lbs., 020 = positive twenty lbs.

Press ENTER key.

NOTE 4: The RC-48 system is pre-programmed with -10 lb. cut-in and cut-out setpoints.

Example: Rack B C.I. PRS. -10 -10

NOTE 5: The first number in the display of both the cut-in and cut-out setpoints is the operating setpoints the system is working under. If the setpoints were being automatically adjusted by a temperature sensor (temperature compensation), the operating setpoints would be indicated here.

4. The display now indicates :

B C.O. PRS. -10 -10 (with the last -10 flashing).

The cut-out pressure setpoint may now be typed in display.

For example: +17 lbs. Press +/- key to toggle - sign to 0 sign. Press 17 for seventeen lbs. Press ENTER key.

5. Display advances and now indicates:

B MIN OFF T.D. 00 (with 00 flashing.)

This is a minimum off time delay. Once a compressor shuts off, it cannot restart for this minimum period. This time delay is typically 3 minutes. Press 03 and then ENTER.

6. Display now indicates:

B MIN ON T.D. 00 (with 00 flashing.)

This is a minimum on time delay. Once a compressor starts, it must remain running for this minimum time. This time delay is typically 1 minute. Press 01 and then ENTER key.

C. TEMPERATURE SENSOR ASSIGNMENT

Before attempting to program either TEMPERATURE CONTROL SETPOINTS or TEMPERATURE COMPENSATION SETPOINTS, we must first assign temperature probes. Probes must be assigned to particular compressor racks prior to attempting to program any temperature parameters for that rack.

For example: Let's assume Rack A is a single compressor that will be temperature controlled and Rack B is a three compressor uneven parallel using one probe for temperature compensation. We have previously designated Rack B as a pressure control rack and would now like to designate Rack A as a temperature control rack before we actually assign a temperature sensor to it. Select Rack A using RACK NUMBER/DESCR key. Toggle +/- key to TEMP. as the control mode for Rack A. We are now ready to assign a temperature sensor to Rack A.

1. Press TEMP. PROBE/DESCR. key. The display indicates:

S E N S O R 0 1

Press 01, then ENTER. Display indicates: RACK A.

Since we do want to assign at least one temperature probe to Rack A, press ENTER.

Probe #1 is now assigned to rack A. We may now type a description of this sensor using the alphabet keys, then press ENTER.

Display now indicates the description and the proper temperature of that probe. Press ENTER. The display indicates:

1 TEMP CONTROL NO

If temperature control is desired, a YES is needed. The +/- key toggles yes/no. Since we do want this sensor to act as the temperature control sensor for Rack A, press +/- key to answer "YES".

Press ENTER key. At this point the display returns to the PROG prompt.

2. Press TEMP PROBE/DESCR. key. Display indicates:

S E N S O R 0 1 (with 01 flashing)

Since we would like to assign another temperature probe press 02 and then ENTER. Display indicates:

RACK A, (with A flashing).

Press "B" since we want to assign probe #2 to rack B.

Press ENTER key.

We may now type a description of this sensor using the alphabet keys.

Then Press ENTER key. Display now indicates description and proper temperature of that probe. Press ENTER.

If the rack we have just assigned a temperature sensor to is a pressure control rack the display advances to:

TEMP COMP 1 NO

If this sensor was to act as the temperature compensation sensor for that rack, press +/- key to toggle display to "YES". We have now assigned temperature sensor #2 to Rack B as a temperature compensation sensor.

Press ENTER key to return to PROG or PROGRAM prompt.

We have now assigned temperature sensor #01 to Rack A and assigned its function as a temperature control sensor. We have assigned temperature #02 to Rack B and its function as a temperature compensation probe one. The RC-48 can accept up to two sensors per rack as compensation probes, so another could be assigned to Rack B in this example if desired.

As we can see, the eight temperature sensor inputs may be used for various functions such as temperature control, temperature compensation of suction pressure setpoints, and temperature alarm.

We will now assign temperature control setpoints to Rack A (which we have already programmed as a temperature control of a single compressor) and compensation setpoints to Rack B (which we have already programmed as a suction pressure control of a parallel rack).

D. TEMPERATURE CONTROL SETPOINTS

With unit in the PROGRAM mode: Place the RC-48 in the Rack A loop by pressing RACK NUMBER/NAME key, selecting A, and pressing ENTER three times to step through the loop.

Press TEMP. CONTROL SETPOINT key. Display will now indicate:

C N T R L S E N S 0 1

Sensor #1 is the sensor that has been assigned to Rack A, so press ENTER. The display will indicate:

A C U T I N S . P . - 5 0 (with the -50 flashing)

We are now ready to enter the proper temperature cut-in setpoint for Rack A. Let's assume we want a cut-in of plus twenty (+20) and a cut-out of plus seventeen (+17). This means the compressor will run if the temperature climbs above +20 F and will shut off if the temperature falls below +17 F.

Press the +/- key to toggle the minus sign to 0 (plus) and then 20 for plus twenty degrees. Press ENTER key. The display will advance to:

A CUT OUT S.P. -50 (with the -50 flashing)

Press the +/- key to toggle minus to plus, and then 17 for plus seventeen degrees. Press ENTER key. The display will advance to:

A MIN OFF T.D. 00 (with the 00 flashing)

Press 03 for a three minute minimum off time delay. The display will advance to:

A MIN ON T.D. 00 (with the 00 flashing)

Press 01 for a one minute minimum on time delay. This means that whenever the compressor starts, it must remain running for at least one minute.

Press ENTER key. The display will advance to PROG.

E. TEMPERATURE COMPENSATION SETPOINTS

Temperature compensation of the suction pressure setpoints is the automatic adjustment of the suction pressure cut-in and cut-out setpoints based on the case temperature as sensed by 1 or 2 temperature sensors. In order to use temperature compensation, we must (1) assign 1 or 2 temperature sensors to the appropriate rack or racks, and (2) program temperature setpoints that will govern the floating of the suction pressure setpoints. We have already assigned sensor #02 to Rack B as a compensation sensor.

With the RC-48 still in the program mode, place unit in the Rack B loop by pressing RACK NUMBER/DESCR key, selecting Rack B, and pressing ENTER key three times to step through the loop. Press the TEMP. COMP. SETPOINT key. The display will indicate:

B 1st SENSOR 02

This indicates that we have assigned sensor #02 to Rack B as compensation sensor #1. Press ENTER. Display will advance to:

B 2nd SENSOR 00

This indicates that we have no second compensation sensor.

If necessary we could have assigned a second temperature sensor to this rack for temperature compensation. However, since we only assigned sensor #02 in this example, press ENTER key to advance to next display. The display will now indicate:

B LO TEMP S.P. -50 (with the -50 flashing)

The LOW TEMPERATURE SETPOINT is the lowest temperature we would allow in the fixture. That is, if the temperature falls below this low setpoint the RC-48 will begin to adjust the suction pressure setpoints upward in one pound increments at each time delay period. This would continue until the temperature rose above this low temperature setpoint.

The HIGH TEMPERATURE SETPOINT is the highest temperature we would allow in the fixture. That is, if the temperature climbs above this high temperature setpoint the RC-48 will begin to adjust the suction pressure setpoints down in one pound increments at each time delay period. This would continue until the temperature fell below this high temperature setpoint. The RC-48 system will not adjust the setpoints below the original cut-in and cut-out setpoints.

The TIME DELAY PERIOD is the delay before any compensation action occurs. That is, if the temperature was either above or below the setpoints, no compensation would occur for at least the time delay period. After that period the suction pressure setpoints would adjust either up or down one pound. Provided the temperature was either above or below the compensation setpoints for the time delay period, the suction pressure setpoints would adjust another one pound.

The MAXIMUM CUT-IN PRESSURE is the highest cut- in pressure allowed by the compensation. We would not allow the suction pressure setpoints to be adjusted above this cut-in setpoint.

NOTE #6: The differential between cut-in and cut-out setpoints remains constant regardless of compensation adjustment.

In the next four steps we can program the LOW TEMPERATURE SETPOINT, the HIGH TEMPERATURE SETPOINT, the TIME DELAY before compensation action occurs, and the MAXIMUM CUT-IN PRESSURE we would ever allow for this refrigeration system. Let's assume we wanted a low temperature setpoint of plus twenty (020), a high temperature setpoint of plus thirty two (032), a compensation time delay of five (5) minutes, and a maximum cut-in pressure allowed of thirty three pounds (33 lbs.).

The display indicates:

B LO TEMP S.P. -50 (with -50 flashing)

Press +/- key to toggle minus sign to 0. Then press 20 and ENTER key. The display will advance to:

B HI TEMP S.P. -50 (with -50 flashing)

Press +/- key to toggle minus sign to 0. Then press 32 and ENTER key. The display will advance to:

B TIME DELAY 01 (with 01 flashing)

Press 05 for a five minute compensation time delay and ENTER key. Display will advance to:

B MAX. C.I. PRES 006 (with the 006 flashing)

Press 033 for thirty three pounds and ENTER key. The display will return to the PROG prompt.

We have in the preceding steps assigned a temperature sensor to Rack B and programmed temperature compensation setpoints - high and low temperature , time delay between floating actions, and a maximum cut-in pressure we would allow the suction pressure setpoints to float to. The procedure for subsequent racks is identical to that outlined above.

F. ALARM SETPOINTS—TEMPERATURE

ALARM TEMPERATURE SETPOINTS may be assigned to any temperature sensor regardless of the function of the sensor. That is, alarm setpoints are not dependent on whether the sensor is being used as a temperature control sensor, a temperature compensation sensor, or only as an alarm sensor. The alarm parameters associated with temperature sensors are high temperature setpoint, low temperature setpoint, and alarm time delay.

The temperature alarm will be activated if the temperature in the fixture is above or below the setpoints for the duration of the time delay.

Press ALARM SETPOINT TEMP. key. The display will indicate:

SENSOR 01 (with 01 flashing)

Press numbers of the appropriate temperature sensor-- 01,02,03, through 08 . This sensor number will remain in the left character of the display throughout the procedure. In this example, we have selected sensor # 1

Example 01: Press ENTER key. Display will advance to:

1 HI TEMP. S.P. -50 (with -50 flashing)

Press +/- key to toggle from negative to positive temperature.

Press numbers of desired high temperature setpoint. For example: 035 (for plus thirty five degrees F.).

Press ENTER key. The display will advance to:

1 LO TEMP. S.P. -50 (with -50 flashing)

Press +/- key to toggle from negative to positive temperature.

Press numbers of desired low temperature setpoint. For example: 020 (for plus twenty degrees F.).

Press ENTER key. The display will advance to:

1 TIME DELAY 00 (with 00 flashing)

Press numbers of desired alarm time delay duration. This time delay period should be sufficiently long enough to account for any defrost periods

Press ENTER key. Display will return to PROG prompt.

G. ALARM SETPOINTS—PRESSURE

The RC-48 SYSTEM has the ability to alarm on a variety of pressure parameters. For any suction or head pressure input, the RC-48 can alarm on high and low pressure setpoints. All pressure alarms have a single ALARM TIME DELAY. The head pressure alarm has an additional suction pressure override feature which allows the RC-48 to cycle compressors off if the head pressure exceeds the head pressure alarm setpoint. This action also activates the RC-48 alarm while attempting to keep as much refrigeration "on" without tripping the compressors internal head pressure safety control.

In the program mode select and enter rack letter, for example Rack B

Press ENTER three times to step through loop.

Press ALARM SETPOINT PRESSURE key. The display will indicate:

B HI SUCT. AL -10 (with -10 flashing)

A desired HIGH SUCTION ALARM pressure setpoint may be programmed by pressing the desired numbers, toggle +/- for positive or negative value, and press ENTER key. The display will advance to:

B LO SUCT. AL -10 (with -10 flashing)

A desired LOW SUCTION ALARM setpoint may be programmed by pressing desired numbers, toggle +/- key for positive or negative value, and press ENTER key.

The display advances to the time delay as indicated by:

B TIME DELAY 00 (with 00 flashing)

The desired TIME DELAY period for all pressure alarms may be programmed by pressing desired numbers and then pressing ENTER key. The display advances to:

B LO HEAD AL 000 (with 000 flashing)

The desired LOW HEAD PRESSURE ALARM setpoint may be programmed by pressing desired numbers; then press ENTER key.

The display will advance to:

B HI HEAD AL 000 (with 000 flashing)

The desired high pressure alarm setpoint may be programmed by pressing desired numbers; then press ENTER key .

The display will advance to:

B HEAD DIFF 000 (with 000 flashing)

The RC-48 system will alarm when the system head pressure exceeds the HIGH HEAD ALARM setpoint for at least the time delay period. The system remains in alarm until the head pressure falls below the HIGH HEAD ALARM setpoint minus this differential.

For example: The HIGH HEAD ALARM setpoint is programmed at 250 lbs. and the DIFFERENTIAL at 25 lbs. If the head pressure exceeds 250 lbs. for the alarm time delay period, the system will alarm. The alarm will not reset until the system head pressure falls below $250 - 25$ or 225 lbs.

A desired HEAD DIFFERENTIAL setpoint may be programmed by pressing the desired numbers.

Example: 025 for 25 lbs. and then the ENTER key. The display will advance to:

B HEAD OVR OFF

The HEAD OVERRIDE function when toggled " ON " allows the RC-48 system to cycle compressors off on a normal cut-out sequence if the head pressure exceeds the HIGH HEAD ALARM setpoint for the programmed time delay period. This may allow the compressor system to continue operating at a reduced capacity, as opposed to allowing the head pressure to possibly increase, causing eventual tripping of the mechanical head pressure safety controls. This situation may occur on an abnormally hot day when there is marginal condensing capability. The RC-48 would alarm on high head pressure, cycle compressors off until the head pressure fell below the HIGH HEAD ALARM setpoint and eventually allow compressors to cycle on once the head pressure fell to the HIGH HEAD ALARM setpoint minus the DIFFERENTIAL.

H. RESET OF HEAD OVER-RIDE FUNCTION

There are two reset modes available with the RC-48 System - AUTOMATIC and MANUAL. In auto mode the system automatically resets after the head pressure falls below the HIGH HEAD ALARM setpoint minus the DIFFERENTIAL. In the MANUAL mode, the RESET key on the keyboard of the RC-48 must be pressed before compressors will be allowed to cycle on.

The MANUAL RESET function serves to reset the HEAD OVER-RIDE when the head pressure falls below the high head pressure alarm setpoint. Pressing the "RESET" key after selecting the correct rack will reset the head over-ride function.

The AUTO RESET function serves to reset the HEAD OVER-RIDE when the head pressure falls below the high head pressure alarm setpoint minus the differential for the reset time delay period.

Example: High Head Alarm Setpoint = 250 lbs.
Differential = 25 lbs.
Reset Time Delay = 5 minutes

If the head pressure exceeded 250 lbs. the RC-48 would:

1. Alarm
2. Cycle compressors off in a normal cut-out sequence.

When the head pressure falls below 250 - 25 (or 225 lbs.) for at least 5 minutes, the alarm will cancel and compressors will be allowed to cycle on if called for.

If the HEAD OVERRIDE function is not desired, simply toggle "OFF" with the +/- key.

Toggle HEAD OVERRIDE ON or OFF with the +/- key . If OFF, the display will revert to PROG (Program Mode). If ON, the display will advance to :

B RESET AUTO

Toggle reset to AUTO or MANUAL with the +/- key. Then press the ENTER key.

The display will advance to:

B RESET T.D. 00 (with the 00 flashing)

Press desired numbers to select the TIME DELAY after the head pressure has fallen below the HIGH HEAD ALARM setpoint minus the DIFFERENTIAL before compressors will be allowed to be cycled ON. Press the ENTER key.

The display will advance to **PROG.**

III. ZERO ADJUST — SUCTION AND HEAD PRESSURE TRANSDUCERS

Each transducer, either suction or head pressure, must be zero adjusted before the RC-48 System is placed in service. The zero adjust procedure, that is adjusting each transducer to read exactly "0" lbs. with no pressure (open to atmosphere) can be done using the keyboard. The procedure is performed in the "PROGRAM" mode, with the appropriate transducer or transducers open to atmosphere.

1. Place unit in the program mode.
2. Select rack by pressing RACK NUMBER/DESCR key and letter of system (A-H)

Press ENTER key three times to step through the loop (this steps through the loop while still maintaining all previously programmed parameters in memory).

3. Press zero adjust key. The display will indicate:

A AUTO ZERO SUCT

Use +/- key to toggle to suction or head pressure transducer.

4. Press ENTER key. The display will indicate:

A AUTO ZERO — (three digits)

The three digit number is the offset in pounds. The transducers used are extremely accurate, but require adjustment for the "zero offset" when initially placed in service. The display should never indicate more than plus or minus five pounds. If the offset is more than this, the transducer may be damaged and should be replaced. The zero offset figure should be recorded for future reference for each transducer, either suction or head.

5. Once offset figure is recorded, press ENTER key. That transducer is now zero adjusted. This means the offset figure is subtracted from the transducer signal, giving an accurate pressure reading.

If it is necessary to zero adjust the head pressure transducer on that system:

6. Press ZERO ADJUST key. The display will indicate:

A AUTO ZERO SUCT

Toggle +/- key. Display will indicate:

A AUTO ZERO HEAD

7. Press ENTER key. Display will indicate offset in pounds (three digits).

Press ENTER key. That transducer is now zero adjusted.

NOTE 7: Head pressure transducers should not exceed 25 lbs. offset.
Repeat this procedure for each transducer on RC-48 System.

8. Once zero adjust procedure is complete, press PROGRAM switch to return RC-48 to "Run" mode. Press PRESSURE SUCTION & HEAD key to interrogate suction and head pressure for the rack that was zero adjusted. This will ensure that the pressure on display reads "0" lbs. before pressurizing transducers on that rack.

A. DAY, DATE, TIME, DAYLIGHT SAVINGS DATES

In the program mode press DAY/DATE/TIME key. Display will indicate:

A DAY 5 (with day number flashing)

Press number of correct day (Sunday = day 1, Monday = day 2, etc.) and press ENTER to record in memory. Display advances to:

A DATE 1225 (with month and day flashing)

Press numbers of correct month and day (Ex: 1225 = Christmas Day). Display advances to:

A HOUR 1510 (with hour in military time flashing)

Press numbers of correct time and then ENTER to start clock. Display advances to:

A YEAR 00 (with year flashing)

Press numbers for correct year (Ex: 85 = 1985). Then press ENTER. Display advances to:

DL SAV ON 0000 (with 0000 flashing)

Press date Daylight Savings time takes effect and then ENTER. Repeat for Daylight Savings "off" date.

When complete, display will revert to PROG.

B. SYSTEM STATUS

The SYSTEM Key operates only in the "RUN" mode.

Select the compressor rack by pressing Rack Number/Description key, then correct rack letter, etc.

Press status key. Display will indicate rack letter, control sequence, actual stage of sequence, and which compressors are running.

Note: X = OFF
0 = ON

Example: A 05 01 XXXX

This indicates Rack A, Sequence 05, (two compressor alternating), stage 1 (all off), with all compressors off.

C. ELAPSED TIME

The ELAPSED TIME Key operates only in the "RUN" mode.

Select appropriate compressor rack. Ex: Rack B

Press ELAPSED TIME key. Display will indicate:

B RACK COMP. 1 Run time in hours and minutes

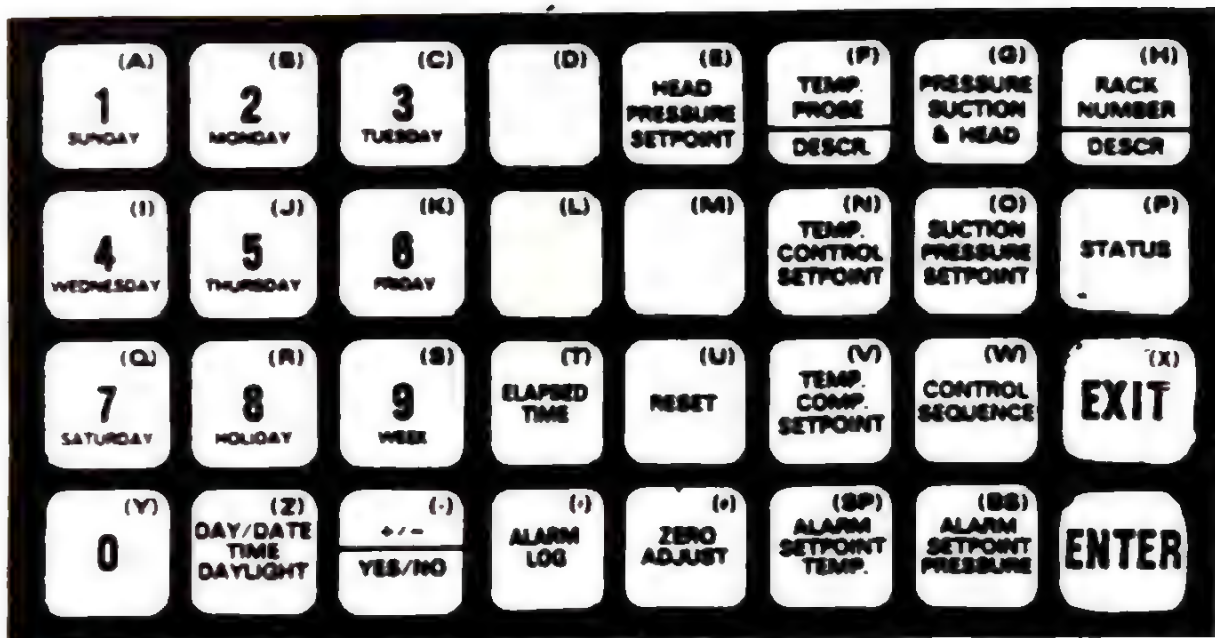
Press ENTER to advance to next compressor elapsed time or EXIT to escape to the run mode.

D. RC-48 ALARM LOG INDICATIONS

<u>Alarm Condition</u>	<u>Alarm Log Indication</u>			
Power Restoration	Power ON	DATE	TIME	
Power Failure	Power OFF	---	---	
High Temperature Alarm	Hi T.	SENSOR #	DATE	TIME
Low Temperature Alarm	Lo T.	-	---	---
		-	---	---
High Suction Pressure	Hi S.	SYSTEM	DATE	TIME
Low Suction Pressure	Lo S.	-	---	---
		-	---	---
High Head Pressure	Hi H.	SYSTEM	DATE	TIME
Low Head Pressure	Lo H.	-	---	---
		-	---	---
Over-ride Switch Engaged	OV EN	LOAD #	DATE	TIME
Over-ride Switch Disengaged	OV DI	--	---	---
		--	---	---

Load numbers refer to specific compressor racks or condensers.

Temperature alarms refer to specific sensors, not compressor racks.



LBRC-48X

EIL RC-4B PROGRAM

RC-4B POSITION

Compressor Unit Data

Rack ID
 Rack Description
 Control Mode (Pres. or Temp.)
 Control Sequence #
 Sequence Description

Suction (or temp.) Set Points

Suction CI
 Suction CO
 Min. Off TD
 Min. On TD
 Zero Offset
 Auto./Manual Zero

Alarm Pressure Setpoints ..

Hi Suction Alarm
 Low Suction Alarm
 Alarm TD
 Low Head Alarm
 High Head Alarm
 Head Diff.
 Head Override On/Off
 Auto./Manual Head Reset
 Reset TD

Temperature Compensation

1st Sensor #
 Description
 2nd Sensor #
 Description
 Low Temp. Setpoint
 Hi Temp. Setpoint
 Time Delay
 Maximum CI

Alarm Temperature Setpoint

Sensor #
 Hi Temp. Setpoint
 Low Temp. Setpoint
 TD

Head Pressure Setpoint

Time Delay - 15,30,45,60
 #1 Setpoint
 #1 Diff.
 #2 Setpoint
 #2 Diff.
 #3 Setpoint
 #3 Diff.
 #4 Setpoint
 #4 Diff.
 Zero Offset
 Auto./Manual Zero

PC-3 POSITION

Compressor Unit Data

Rack ID
 Rack Description
 Control Mode (Pres. or Temp.)
 Control Sequence #
 Sequence Description

Suction (or temp.) Set Points

Suction CI
 Suction CO
 Min. Off TD
 Min. On TD
 Zero Offset
 Auto./Manual Zero

Alarm Pressure Setpoints

Hi Suction Alarm
 Low Suction Alarm
 Alarm TD
 Low Head Alarm
 High Head Alarm
 Head Diff.
 Head Override On/Off
 Auto./Manual Head Reset
 Reset TD

Temperature Compensation

1st Sensor #
 Description
 2nd Sensor #
 Description
 Low Temp. Setpoint
 Hi Temp. Setpoint
 Time Delay
 Maximum CI

Alarm Temperature Setpoint

Sensor #
 Hi Temp. Setpoint
 Low Temp. Setpoint
 TD

Head Pressure Setpoint

Time Delay - 15,30,45,60
 #1 Setpoint
 #1 Diff.
 #2 Setpoint
 #2 Diff.
 #3 Setpoint
 #3 Diff.
 #4 Setpoint
 #4 Diff.
 Zero Offset
 Auto./Manual Zero

RC-48 PRESSURE CONTROL

Refer to second page for current program

- TO CHECK RACK SYSTEM DESIRED - press - RACK
NUMBER - enter rack letter (A thru H) - press - ENTER - display shows rack description - press - ENTER - display shows if control is pressure or temp. - press - ENTER - display shows time of day in military time.

- TO CHECK CURRENT SUCTION AND/OR HEAD PRESSURE AFTER DESIRED SYSTEM IS SELECTED - press - PRESSURE
SUCTION - display shows suction pressure - press - PRESSURE
SUCTION - again - display shows head pressure - Pressures should be near the programmed setpoints. This key can toggle back & forth to read either suction or head pressures.

- TO CHECK CURRENT STATUS ON SYSTEM - After desired system is selected - press - STATUS - display will show rack letter, sequence #, and 4 X's or O's in any combination - if an O is displayed first, the first compressor should be "ON" - O = compressor "ON", X = compressor "OFF"

- TO CHECK ALARMS - press - ALARM
LOG - display will show most recent alarm first, continue to press - ALARM
LOG - to see previous alarms

IV. LOAD NUMBERS

RC-48, RC-48A, RC-48B

The RC-48 System has the potential to control 32 compressors (eight racks with up to four compressors each), and 32 condenser fans, or banks of fans. Each compressor output on the RC-48 Main System and the condenser fan output on the RC-48A Slave System, is assigned a load number.

Load numbers occur in the alarm log when an over-ride switch is either engaged or disengaged. For example: Compressor Rack A is designated as load 00 as indicated in the chart below. If any compressor on Rack A is placed in over-ride, it will be indicated as 00 in the alarm log. Individual compressor or condenser fan load numbers occur when using the keyboard over-ride or the keyboard interrogation of an individual load status.

Alarm Log of Over-ride Engage or Disengage

<u>Compressor Rack</u>	<u>Load #</u>
------------------------	---------------

Rack A	00
Rack B	04
Rack C	08
Rack D	12
Rack E	16
Rack F	20
Rack G	24
Rack H	28

Condenser Fan Bank

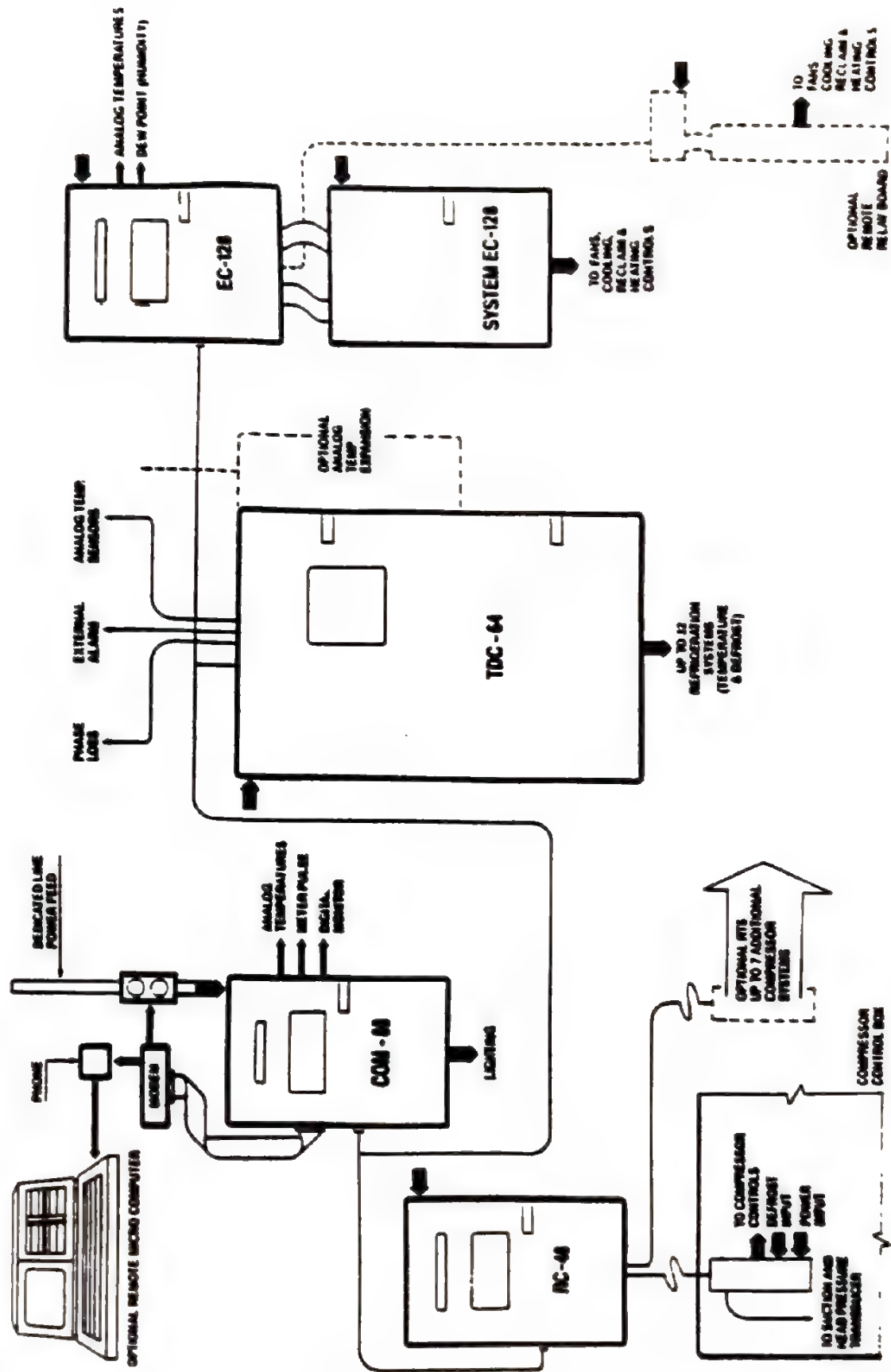
A	32
B	36
C	40
D	44
E	48
F	52
G	56
H	60

Listed below are individual compressor and condenser fan output load numbers for the purpose of load status inquiry or individual unit keyboard over-ride:

<u>RC-48, RC-4</u>			<u>RC-48A</u>		
<u>Rack</u>	<u>Compressor</u>	<u>Load</u>	<u>Rack</u>	<u>Compressor</u>	<u>Load</u>
A	#1	01	A	#1	33
	#2	02		#2	34
	#3	03		#3	35
	#4	04		#4	36
B	#1	05	B	#1	37
	#2	06		#2	38
	#3	07		#3	39
	#4	08		#4	40
C	#1	09	C	#1	41
	#2	10		#2	42
	#3	11		#3	43
	#4	12		#4	44
D	#1	13	D	#1	45
	#2	14		#2	46
	#3	15		#3	47
	#4	16		#4	48
E	#1	17	E	#1	49
	#2	18		#2	50
	#3	19		#3	51
	#4	20		#4	52
F	#1	21	F	#1	53
	#2	22		#2	54
	#3	23		#3	55
	#4	24		#4	56
G	#1	25	G	#1	57
	#2	26		#2	58
	#3	27		#3	59
	#4	28		#4	60
H	#1	29	H	#1	61
	#2	30		#2	62
	#3	31		#3	63
	#4	32		#4	64

SUPERMARKET SYSTEMS

1



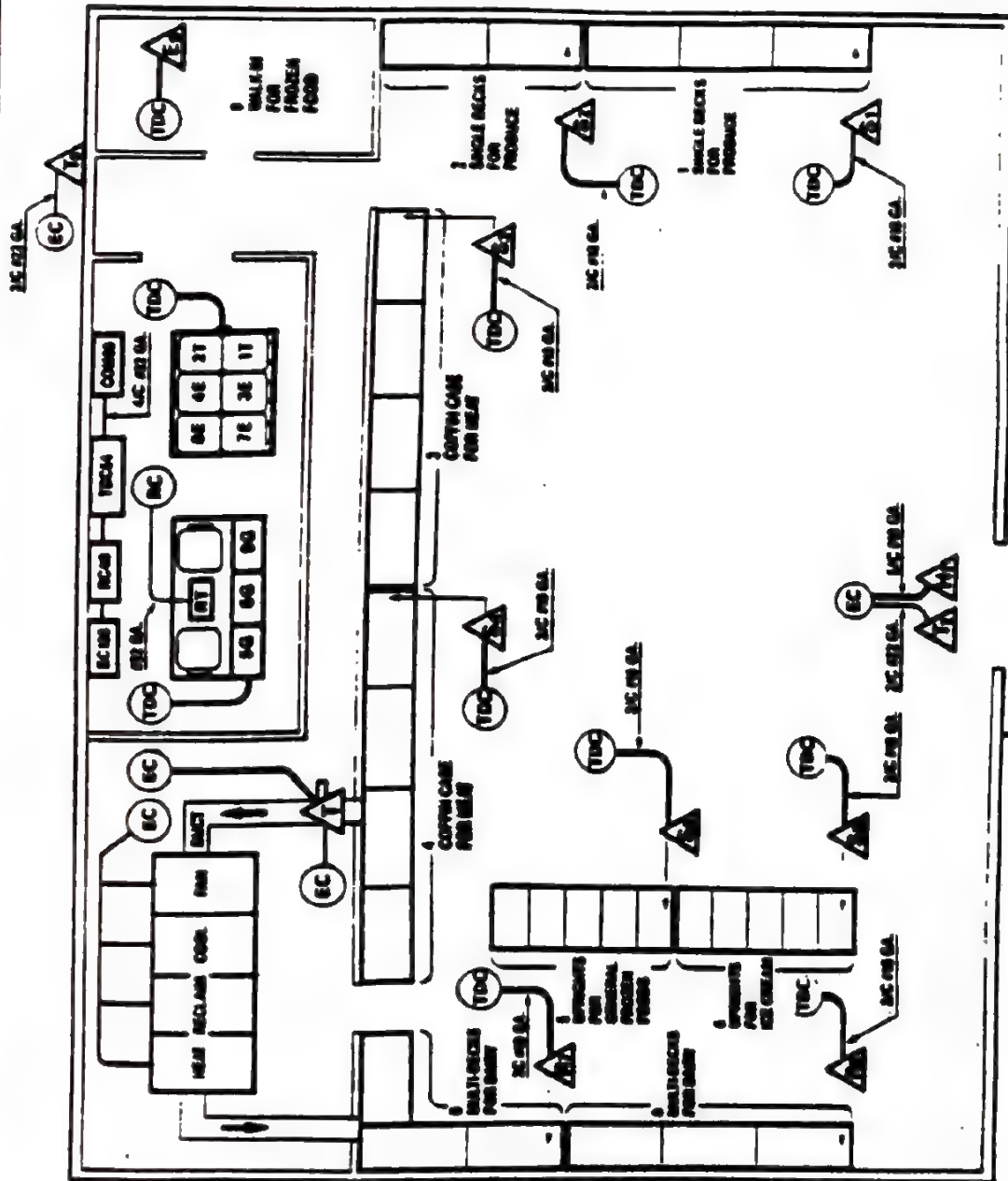
COMPONENT REFERENCE

2

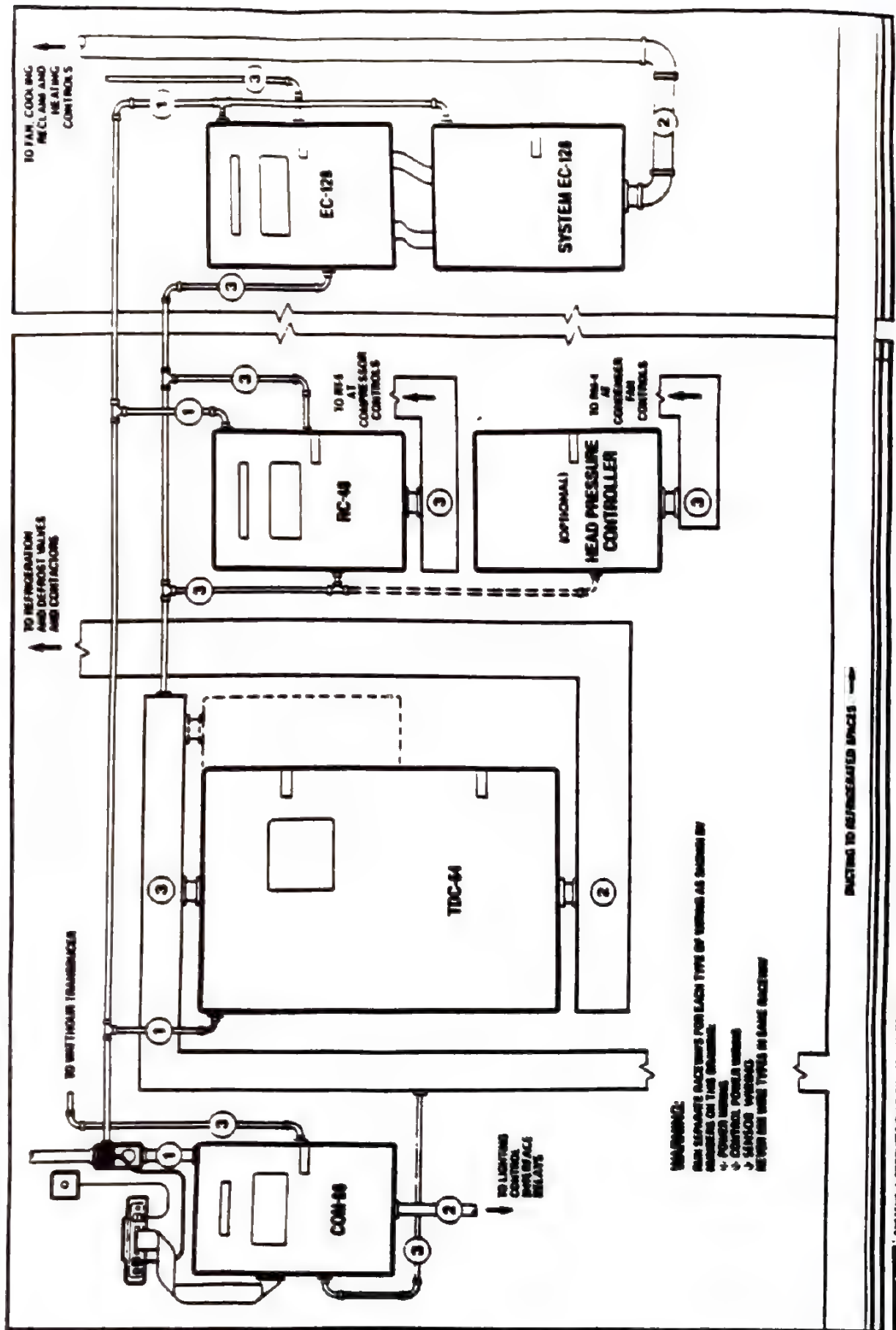
REFERENCE	ABBREVIATION	SYMBOL	PICTURE	REFERENCE	ABBREVIATION	SYMBOL	PICTURE
CURRENT TRANSFORMER	CT			TEMPERATURE	TEMPERATURE		
WAVES SHARD MODEL	SM			REFRIGERATION TEMPERATURE SENSORS	REFRIGERATION TEMPERATURE SENSORS		
LIGHTING CONTROL BOX	LC			SUPPLY AIR	SA		
SENSOR (PICK)	TD			RETURN AIR	RA		
SENSOR (PICK)	T			EVAPORATOR	EV		
RECURRENT SENSOR (PICK)	H			COMPRESSOR CONTROL REMOTE THERMAL UNIT	RT		
SENSOR (PICK)	TO			WIRE BUNDLE	WIRE BUNDLE		
COM	CM			WIRING IN THERMAL PAGES	WIRING IN THERMAL PAGES		
EC	RC						
EC	EC						
TDC	TDC						
QUALITY METER	UM						
WATER TRANSDUCER	WT						
WIRING RUN	WR						

SAMPLE BUILDING LAYOUT

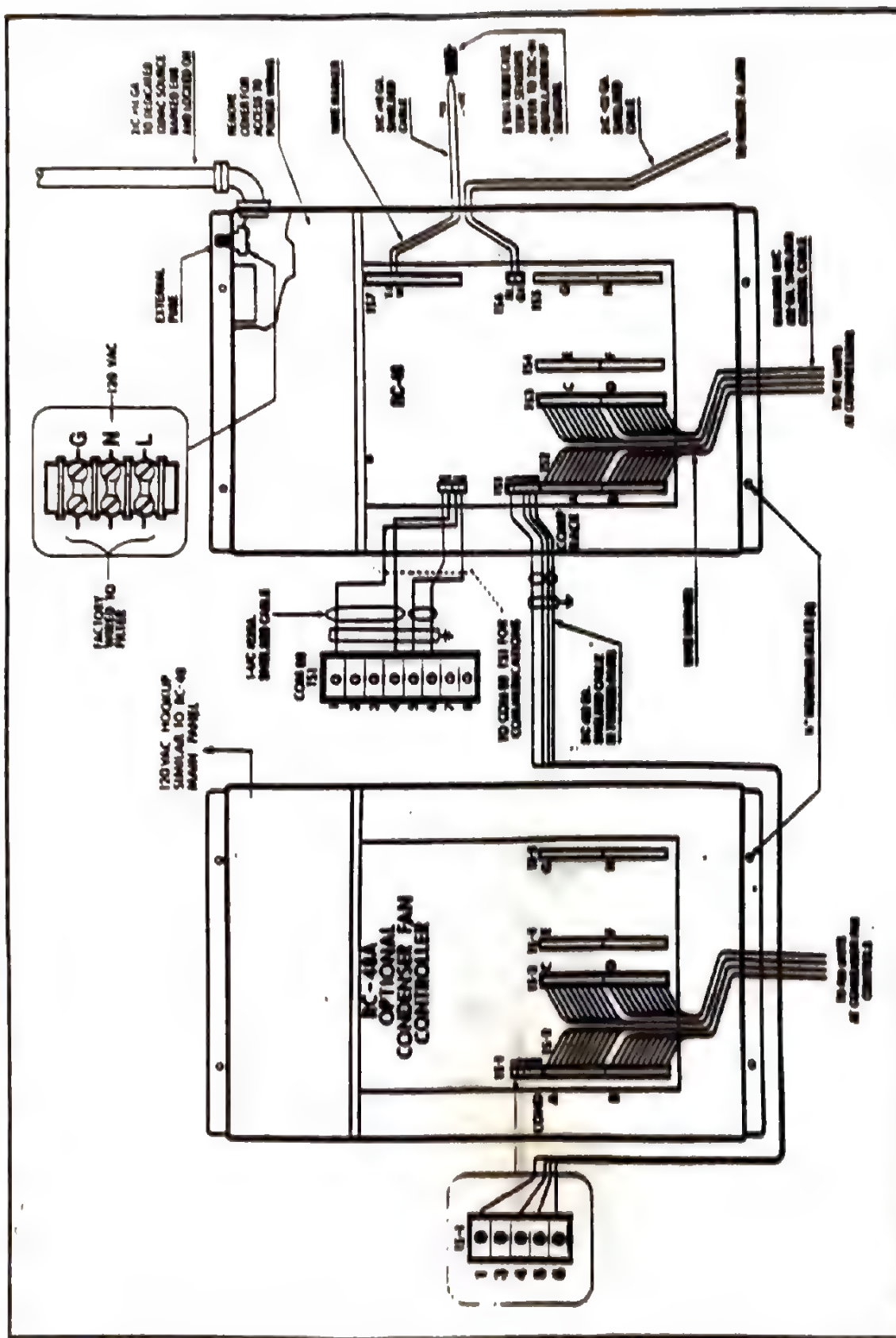
3



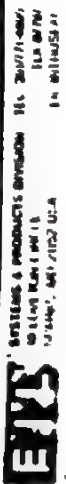
• REFRIGERATION NUMBER
 • ELECTRIC DEFROST
 • GAS DEFROST
 • THERM OFF DEFROST
 • SEE COMPONENT REFERENCE
 FOR ADDITIONAL SYMBOLS



RC-48 + RC-48A MOUNTING + HOOKUP

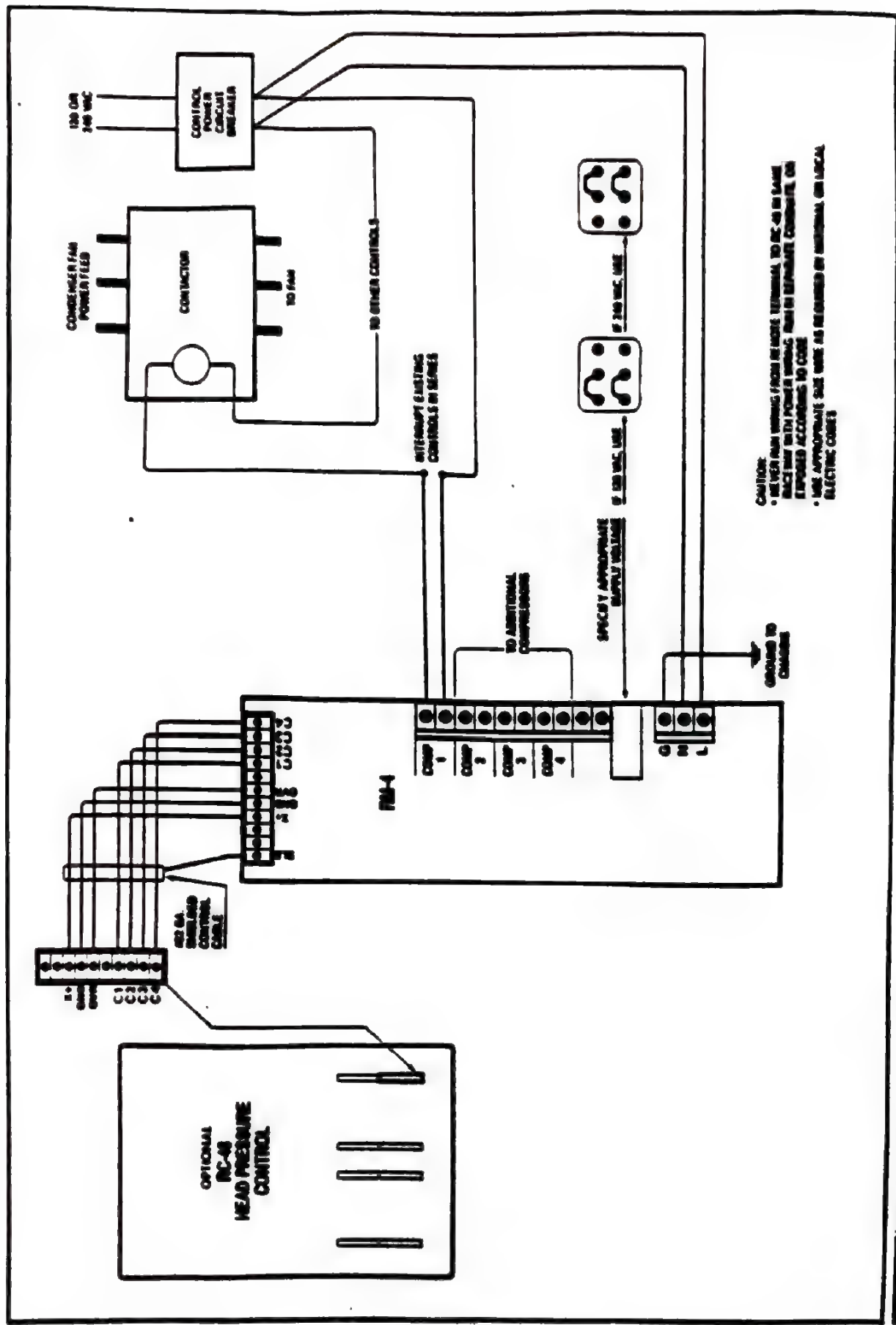


THE

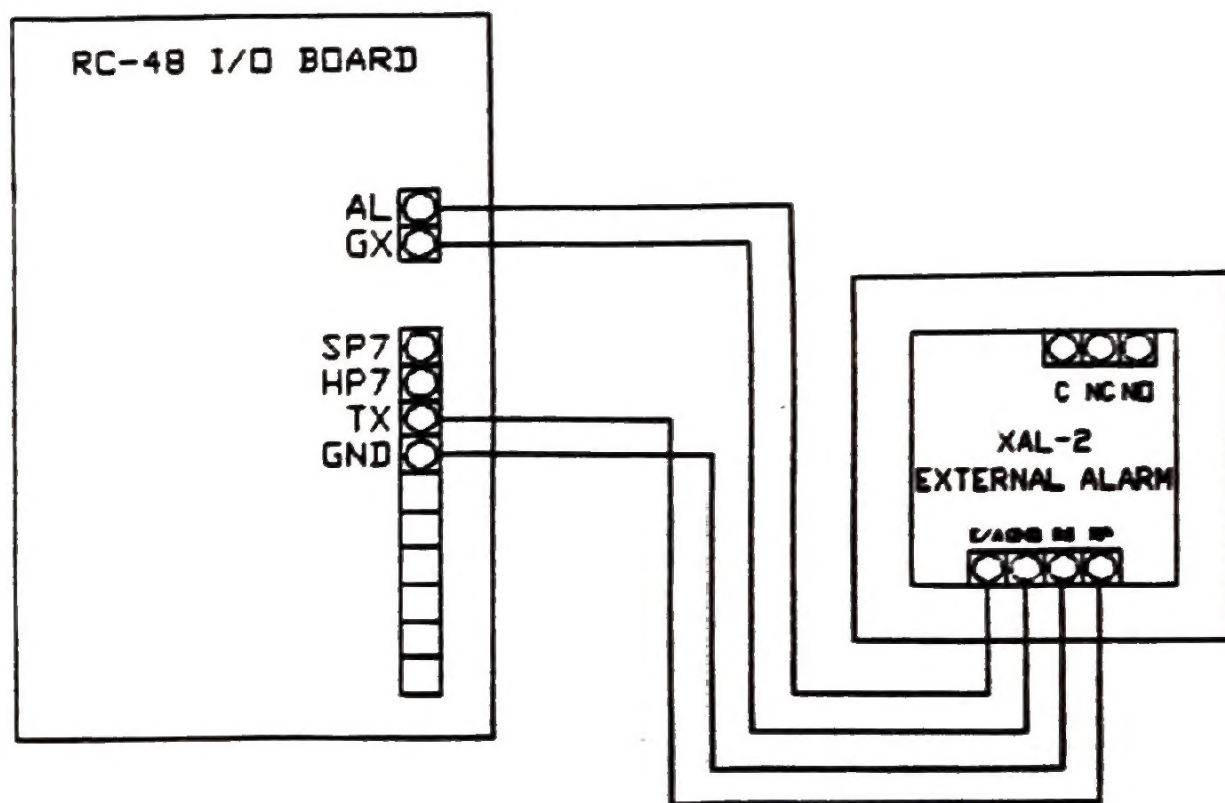


RM-4 INTERFACE

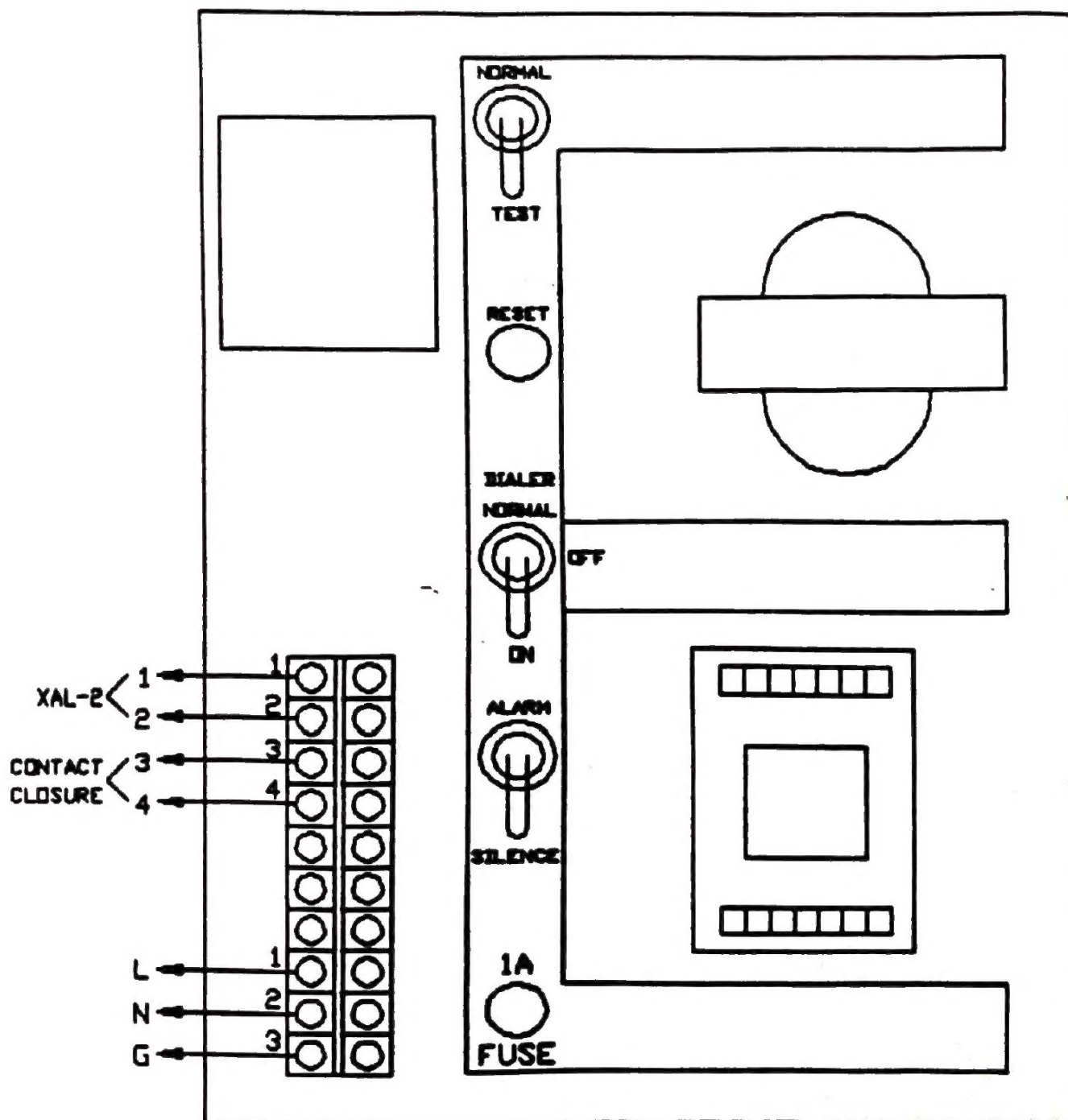
15



EXTERNAL ALARM INSTALLATION WIRING DIAGRAM



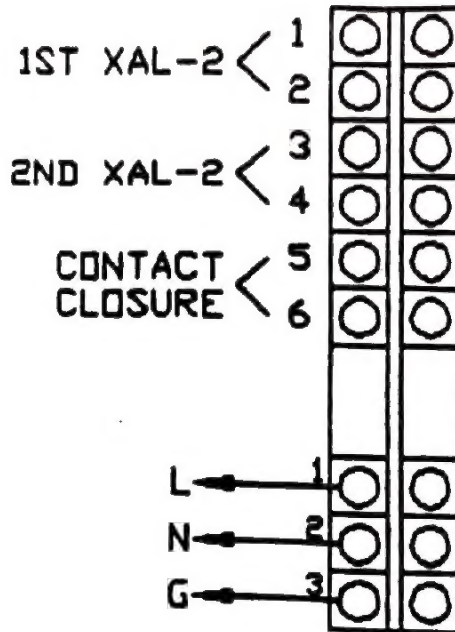
RA-1 REMOTE ALARM INSTALLATION DIAGRAM



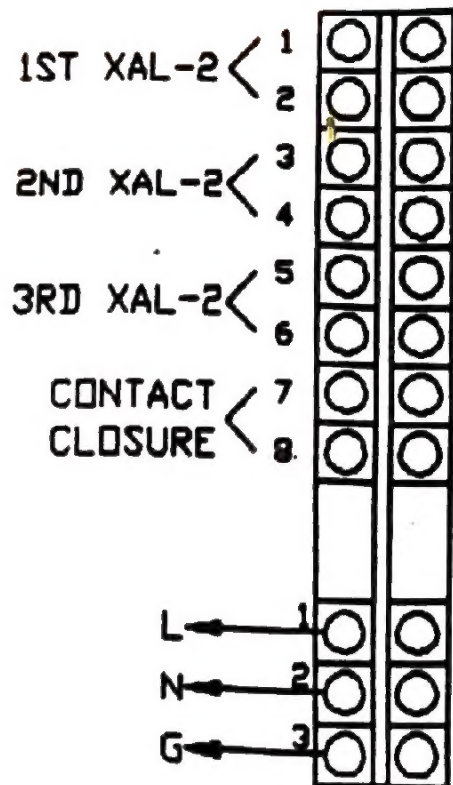
NOTES:

1. TERMINALS 1 AND 2 ARE FROM XAL-2 (EXTERNAL ALARM MOD.)
2. TERMINALS 3 AND 4 ARE DRY CONTACTS RATED AT 3 AMPS AT 120 V. THESE CONTACTS MAY BE USED FOR ENERGIZING A TELE. DIALER, ALARM LIGHT, ETC.
3. INPUT POWER IS 110 VAC/60 HZ.
4. THIS DIAGRAM ILLUSTRATES CONNECTIONS FOR RA-1. TERMINAL CONNECTIONS FOR RA-2, RA-3, AND RA-4 ARE ON FOLLOWING PAGE.

RA-2



RA-3



RA-4

